

WHAT IS CLAIMED IS:

1. A magnetic semiconductor memory device comprising:

a semiconductor substrate;

first and second word lines arranged in parallel to each other on the semiconductor substrate;

a bit line crossing the first and second word lines via an insulator layer; and

a memory cell including a transistor disposed between the first word line and the bit line and a magnetic resistance element disposed between the second word line and the bit line;

wherein the magnetic resistance element is formed into a pillar-like shape by patterning a plurality of layered structures formed on the semiconductor substrate, and at least the side surface is covered with the second word line via the insulator layer.

2. A magnetic semiconductor memory device comprising:

a semiconductor substrate;

first and second word lines arranged in parallel to each other on the semiconductor substrate;

a bit line crossing the first and second word lines via an insulator layer; and

a memory cell including a transistor disposed between the first word line and the bit line and a magnetic resistance element disposed between the second word line and the bit line;

wherein the magnetic resistance element is formed into a pillar-like shape by patterning a plurality of layered structures formed on the semiconductor substrate, and the top surface and two side surfaces are covered with the second word line via the insulator layer.

3. A magnetic semiconductor memory device as claimed in claim 1, wherein the direction of an electron traveling in a channel area is perpendicular to the main surface of the semiconductor substrate in the transistor.

4. A magnetic semiconductor memory device as claimed in claim 1, wherein a channel is made of polycrystalline silicon in the transistor.

5. A magnetic semiconductor memory device as claimed in claim 1, wherein at least the upper surface of the bit line is covered with a soft magnetic film.

6. A magnetic semiconductor memory device as claimed in claim 1, wherein at least one surface of the second word line is covered with a soft magnetic film.

7. A magnetic semiconductor memory device as claimed in claim 1, wherein the magnetic resistance element is a layered structure including a ferromagnetic material, a

tunnel insulator film and a ferromagnetic film.

8. A magnetic semiconductor memory device as claimed in claim 1, wherein the second word line surrounds the bit line in at least three directions via the insulator film.

9. A magnetic semiconductor memory device as claimed in claim 1, wherein the soft magnetic film is permalloy ($\text{Ni}_{81}\text{Fe}_{19}$).

10. A magnetic semiconductor memory device as claimed in claim 5, wherein the bit line extends between the first and second word lines.

11. A magnetic semiconductor memory device as claimed in claim 1, wherein the bit line extends between the second word line and the magnetic resistance element.

12. A magnetic semiconductor memory device as claimed in claim 1, wherein the magnetic resistance element is formed into a rectangular shape having short sides and long sides, the direction of the long side being perpendicular to the bit line.

13. A magnetic semiconductor memory device comprising:

a semiconductor substrate;

a plurality of word lines formed on the semiconductor substrate;

a plurality of bit lines crossing the plurality of word lines; and

a memory array including memory cells arranged at crossing points between the plurality of word lines and the plurality of bit lines;

wherein the memory cell includes a vertical type transistor having a channel area formed in a direction perpendicular to the main surface of the semiconductor substrate and a magnetic resistance element disposed above the vertical type transistor, the word line being a gate electrode of the vertical type transistor and covering at least two side surfaces of the magnetic resistance element via an insulator film.

14. A magnetic semiconductor memory device as claimed in claim 13, wherein at least the upper surface of the bit line is covered with a soft magnetic film.

15. A magnetic semiconductor memory device as claimed in claim 13, wherein at least one surface of the second word line is covered with a soft magnetic film.

16. A magnetic semiconductor memory device as claimed in claim 13, wherein the magnetic resistance element is formed into a rectangular shape having short sides and long sides, the direction of the long side being perpendicular to the bit line.

17. A magnetic semiconductor memory device as claimed in claim 13, wherein a spin flips its direction by varying the direction of a current flowing in the bit line,

thus reversing data accordingly.

18. A magnetic semiconductor memory device as claimed in claim 2, wherein the direction of an electron traveling in a channel area is perpendicular to the main surface of the semiconductor substrate in the transistor.

19. A magnetic semiconductor memory device as claimed in claim 2, wherein the second word line surrounds the bit line in at least three directions via the insulator film.

20. A magnetic semiconductor memory device as claimed in claim 2, wherein at least one surface of the second word line is covered with a soft magnetic film.